U. S. Trade Policies and Their Impact on Domestic Vegetables, Fruits and Nuts Sector: Application of the GTAP-HS Modelling Framework

Abstract

Reversing a long-lasting consensus on trade liberalization, one of the first actions of President Trump's Administration in the trade policy arena was to leave the Trans-Pacific Partnership (TPP) negotiations in January 2017. Justified on national security considerations,[1] in March 2018 the Administration imposed tariffs of 25% on steel and 10% on aluminum imports from most countries. Most of the U.S. trading partners initiated retaliatory tariffs, extending well beyond these two commodities and in many cases covering a broad number of U.S. agricultural exports. One of the targeted U.S. agricultural sectors is vegetables, fruits and nuts, which includes highly diversified set of over hundred individual commodities and represents over 21% of the U.S. agricultural exports. For some of the individual 'tariff lines', tariff rates could reach up to 100% (Table 1).

Table 1: Selected retaliatory import tariffs imposed on U.S. vegetables, fruits and nuts

HS6 code	Commodity description	U.S. trading partner	Imposed import tariff, %	Export value in 2017, million USD	Share in the U.S. aggregate commodity exports, %
080211	Almonds	India	10	583.4	54.0
080810	Apples		30	96.8	9.9
080231	Walnuts		100	58.6	11.5
080810	Apples	Mexico	20	274.8	28.1
200410	Potatoes		20	149.4	13.1
080929	Cherries	China	40	121.6	20.2
080510	Oranges		40	48.3	7.5
080251	Pistachios		40	37.9	2.8
080231	Walnuts	Turkey	5	115.6	22.6
080212	Almonds		5	82.3	2.5
071333	Kidney beans	EU28	25	100.6	45.3
200893	Cranberries		25	86.3	32.5

Source: UN (2018), Li (2019).

While increasing trade barriers through protectionist measures, the current Administration is also renegotiating some of the existing trade agreements. These include the United States-Mexico-Canada Agreement (USMCA).[2] In this dynamic context, several recent studies have employed different methodologies to conduct the impact assessment of such policies (e.g. Zheng et al. 2018, Countryman and Muhammad 2018, Chepeliev et al. 2018). One of them is computable general equilibrium models, which have become widespread method to capture the economy-wide and sectoral impacts of agricultural trade policies (e.g. Chepeliev et al. 2018, Beckman and Arita 2016). However, when it comes to the assessment of specific interventions, the level of aggregation in these models is often deemed too coarse to inform negotiations. This is particularly true in the case of sectors where protection levels and characteristics vary dramatically across commodities (Narayanan et al., 2010). For example, in the Global Trade Analysis Project (GTAP) data base used with many CGE models, all vegetables, fruits and nuts are represented under one sector. However, in reality, this sector covers more than one hundred tariffs lines, each with potentially different policies. Another problem with aggregation stems from the fact that there exist huge variations in tariff rates across different tariff lines for many commodities, along with differences

[1] Through the invocation of Section 232 of the Trade Expansion Act of 1962.

[2] The USMCA—at times referred to as NAFTA 2.0— represents a renovated North American Free Trade Agreement (NAFTA), which has been in place for nearly 25 years.

in 'tariff rate quotas' (Grant et al., 2007), the marginal impact of which can vary dramatically depending on which TRQ regime is active. Finally, sectoral analysis in CGE models may result in 'false competition'. For example, two countries can potentially face no direct competition at the disaggregated commodity level (i.e., they ship different products to the same market – e.g., apples and oranges), but at an aggregate level, they may appear to be competitors, since they each send products within the broader sector aggregate (vegetables, fruits and nuts) to the same market.

Analysis at the individual commodity level is something that is typically provided by partial equilibrium (PE) models (Zheng et al. 2018, Peterson et al. 2017). However, PE models deprive analysts of the benefits of an economy-wide perspective, which is required to examine the overall impacts of a broad-based trade policy, including impacts on employment and welfare. To overcome such limitations, a number of studies have employed a hybrid framework. In particular, Grant et al. (2007) link GTAPinGAMS (Rutherford and Paltsev, 2000) with a sub-sector PE model to conduct an analysis of trade policies in the dairy sector. Inspired by Grant et al. work, Narayanan et al. (2010) modify standard GTAP CGE model (Hertel, 1997) by disaggregating automotive trade and apply it to the analysis of multi-lateral tariff liberalization for the Indian automotive industry. In this paper, we refer to these hybrid models within the GTAP family as GTAP-HS where the HS stands for "Harmonized System" to denote modeling at, or close to, the individual tariff line. Aguiar et al. (2019) further generalize the GTAP-HS modelling and data processing approach developed in Narayanan et al. (2010) and resync it with the GTAP v7 model (Corong et al., 2017). All these studies show that the GTAP-HS modelling framework is more flexible and superior to the standalone GTAP applications.

However, the high level of commodity detail provided by the GTAP-HS framework must be supported by disaggregated input data, including bilateral trade flows, protection rates, domestic production and demand – all identified at the tariff line level (or level of commodity disaggregation if it differs from the tariff line level).

Existing studies use different approaches to construct the databases underlying GTAP-HS. While bilateral trade flows and protection rates are readily available at the tariff line level (ITC, 2018), this is not the case for the domestic production and demand data. To estimate these values, Grant et al. (2007) use constrained optimization to minimize deviations at the aggregate sectoral level, given disaggregated trade data. Narayanan et al. (2010) and Aguiar et al. (2019) assume a uniform ratio of the domestic consumption to imports within the disaggregate sector. Both of these approaches are inherently *ad hoc*, and therefore potentially misleading in the context of highly heterogeneous commodities (such as vegetables, fruits and nuts sector).

Introduction of the disaggregated trade, production and consumption flows in the GTAP-HS framework also requires additional consumption and production structures specified via constant elasticities of substitution (CES) and constant elasticities of transformation (CET) functions. These include elasticities of transformation between disaggregated commodities supplied by an aggregate GTAP sector, substitution between different import suppliers at the disaggregate level, substitution between domestic and imported commodities at the disaggregate level, as well as substitution in consumption at the disaggregate commodity level. Assumptions of uniformity in elasticities across disaggregated commodities have generally been applied in the earlier studies (Grant et al. (2007), Narayanan et al. (2010), Aguiar et al. (2019)). This is clearly another important limitation.

In this paper, we contribute to the development of the GTAP-HS framework in following ways. First, we construct the GTAP-HS database with GTAP vegetables, fruits and nuts sector disaggregated into 79 commodities. In so doing, we rely on the Food and Agricultural Organization (FAO) data (FAO, 2018), which allow us to explicitly estimate output and domestic absorption at the disaggregate commodity level.

Second, to capture the heterogeneity in substitution possibilities among different import supplies at the disaggregate commodity level, newly available HS6 level elasticity estimates (Fontagné et al., 2019) are introduced to the GTAP-HS modelling framework.

Finally, we apply the developed modelling framework to the assessment of the ongoing trade frictions between US and its trading partners with a specific focus on vegetables, fruits and nuts (VFN) sector. We compare simulation results between GTAP and GTAP-HS frameworks and seek to explain the sources of significant differences in the estimated impacts of trade policy changes. Based on the estimates of the standard errors provided in Fontagné et al. (2019), we conduct the sensitivity analysis of our policy simulations with respect to the values of trade substitution elasticities. We also compare our results with the case when GTAP-HS database is constructed without knowledge of output and domestic absorption at the disaggregate commodity level, following approach outlined in Narayanan et al. (2010).

The additional data structures (production, consumption and trade) and substitution/transformation possibilities at the tariff line level makes the GTAP-HS framework much more flexible than the standard GTAP model. With multiple contributing factors, understanding of the key driving forces of such differences in results is a major point of the GTAP-HS analysis reported in this paper. Comparisons between GTAP-HS and standard GTAP model show that GTAP-HS model reports lower reduction in U.S. VFN exports than the standard GTAP. At the same time, the magnitude of these differences depends critically on the specification of trade elasticities. If only tariffs on U.S. VFN exports (Scenario 1 in this paper) are considered, U.S. VFN exports fall by 6.8% under the standard GTAP model. GTAP-HS with trade elasticities adopted from the standard GTAP model reports a U.S. VFN export reduction of 4.0%, while GTAP-HS with trade elasticities sourced from Fontagné et al. (2019) (on average much higher than in the standard GTAP) shows U.S. VFN exports reduction of 5.0%.

Higher trade elasticities mean that U.S. trading partners that imposed import tariffs have better opportunities for switching to other import sources and substituting VFN imports by domestic production. Therefore, U.S. VFN exports reduction to China, India and Agricultural Exporters under Fontagné et al. (2019) trade elasticities is much higher than under the Standard elasticities. Although there is a higher increase in U.S. VFN exports to other destinations, this expansion does not fully outweigh additional export losses (under the Fontagné et al. (2019) trade elasticities relative to the Standard elasticities).

Our simulations also suggest that if import tariffs on vegetables, fruits and nuts are considered in isolation from import tariffs imposed on other commodities (Scenario 1), U.S. VFN exports experience a much higher reduction than in the case when VFN tariffs are considered in the context of other retaliations (trade frictions with China and other trading partners – Scenarios 2 and 3 in this paper). The explanation behind such difference is that under Scenario 1 only VFN commodities face increasing import tariffs and producers are switching to other commodities, increasing their output and exports. At the same time, under Scenarios 2 and 3, other commodities, in addition to vegetables, fruits and nuts, also experience increasing import tariffs. In some cases, those tariff increases are even higher than for vegetables, fruits and nuts, therefore there is much less switching to the production and exports of other commodities.

Selected References

Chepeliev, M., Tyner, W., and van der Mensbrugghe, D. 2018. How U.S. Agriculture Will Fare Under the USMCA and Retaliatory Tariffs. GTAP Working Paper No. 84. https://www.gtap.agecon.purdue.edu/resources/download/9147.pdf

Fontagné L., Martin P., Orefice G. (2019) Product-Level Trade Elasticities. CEPII Working Paper No 2019-17. http://www.cepii.fr/PDF_PUB/wp/2019/wp2019-17.pdf

Grant, J.H., Hertel, T.W., Rutherford, T. 2007. Tariff line analysis of US and international dairy protection. Agricultural Economics, 37(s1), pages 271-280.

Li, M. 2019. CARD Trade War Tariffs Database. https://www.card.iastate.edu/china/trade-war-data/

Narayanan, B., Hertel, T., and Horridge, M. 2010. Linking Partial and General Equilibrium Models: A GTAP Application Using TASTE. GTAP Technical Paper 29, Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University.

Zheng, Y., Wood, D., Wang, H.H. and Jones, J.P. 2018. Predicting Potential Impacts of China's Retaliatory Tariffs on the US Farm Sector. Choices, 33(2), pp.1-6.